2021

SURGE Newsletter Newsletter Spring 2021

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Monterey, California. Naval Postgraduate School

SURGE
ENERGY ACADEMIC GROUP QUARTERLY NEWSLETTER SPRING 2021

Highlights

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Ambassador Richard Morningstar
Battery Reactivity

Russia's Dangerous Game: Mutually Assured Darkness?

By Lawrence M. Walzer
Faculty Associate-Research,
Energy Academic Group

While many Americans were distracted with other headlines in the fall and early winter closing out 2020, there were several reports of alleged Russian hacking into all levels of U.S. energy infrastructure and systems including into the Department of Energy.

Increasingly, the United States is confronted with a strategic environment of intense Great Power Competition and persistent hybrid threats where the energy sector can be used to leverage governments politically through potential energy market manipulation or—more dangerously—via targeted attacks on energy infrastructure. While there are concerns regarding China, Iran, North Korea, and some non-state actors, Russia remains a very prominent hybrid threat actor on many fronts and in many regions—some far away, others closer to home. As we seemingly enter a new era of potential Mutually Assured Darkness, the recent blackouts in Texas and other areas highlight that it is more than just the lights that go out.

Most will recall Russia's aggression and attacks on Ukraine, which led to the first reported blackouts caused by a cyberattack in 2015. Russia's deliberate hybrid campaign led to its illegal occupation of Crimea making the Kremlin an international pariah in the West and beyond. Nonetheless, its advancement of the Nord Stream 2 pipeline both furthers its energy influence in Western Europe and attempts to weaken Ukraine in order to punish Kyiv for its steadfast goals to escape Moscow's yoke and align with the liberal West. Russia's hardball antics go far beyond Ukraine and the previous incursions in Georgia, as Russia aggressively seeks to return a perceived sphere of influence into its fold. Volunteers are few.

Much closer to home, cyberattacks into our election apparatus and energy infrastructure—reportedly at the hands of the most sophisticated Russian-directed hackers—paint a stark picture of our vulnerabilities, which Russia

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undoubtedly seeks to exploit in order to achieve its objectives of returning to great power status and broadening its scope and influence on an international scale. While many Americans were distracted with other headlines in the fall and early winter closing out 2020, there were several reports of alleged Russian hacking into all levels of U.S. energy infrastructure and systems including into the Department of Energy.

Deterring our adversaries from conducting hybrid attacks will take a whole of government and comprehensive approach in partnership with the private sector, and also a determined team effort with our allies and other partners. The Naval Postgraduate School will do its part with its recently approved Center on Combating Hybrid Threats, which will focus initial research efforts on Russia, energy, and naturally, hybrid threats in the maritime domain. We must do far more than keep the lights on.

LEARN MORE
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Defense Energy Certificate Awardees

Dr. Dan Nussbaum and the Energy Academic Group (EAG) congratulate Cohort III students for completing the Defense Energy Certificate, and also acknowledge their hard work and dedication to the program. Upon conclusion of the winter quarter, we conferred certificates to 24 students. Feedback from these talented students indicates a worth-while and "eye-opening" experience, with a practical application to address DoD needs.

EAG's Defense Energy Certificate program is a graduate-level accredited certificate program consisting of four courses, offered via Distributed Learning on a pace of one course per quarter for four consecutive quarters. The program is open to all federal civilian employees and active duty military. It provides those working military and civilian employees the opportunity to gain an understanding of the complex issues facing the Operational and Installation Energy segments of the DoD.

We are pleased to report that Cohort IV began the program on 29 March 2021 with a capacity-filled class of 30 students. Cohort Five is expected to begin on 28 March 2022 with an announcement scheduled for 1 October 2021. For more information, or to apply, email Kevin Maher at **kjmaher@nps.edu.**

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FROM THE CHAIR

Dan Nussbaum, Chair of the Energy Academic Group

In this article I address three issues: climate change concerns of the new administration; geopolitical implications of a natural gas pipeline; and a recent development in assessing issues in hybrid warfare.

Every new administration comes with its own priorities. For example, the Biden administration has reintroduced climate change as an aspect of National Security, reviving what has been an in-and-out topic ever since the 1990s when the U.S. Naval War College issued ***Global Climate Change Implications for the United States***, which found that "Naval operations in the coming half century may be drastically affected by the impact of global climate change." Later, in October 2003, the National Defense University published a report stating that "global warming could have a chilling effect on the military." In 2018, the National Defense Authorization Act (NDAA) addressed the vulnerabilities to military installations over the next two decades and warned that rising temperatures, droughts, and famines might lead to more failed states—which are "breeding grounds of extremist and terrorist organizations." Now, President Biden's Executive Order (EO) establishes climate considerations as an essential element of U.S. foreign policy and national security. The EO commissions a "National Intelligence Estimate on the security implications of climate change," and it directs DoD to "develop plans to adapt to a warming world." The recent announcements of Mr. Joe Bryan and Mr. Richard Kidd as senior officials in the Pentagon are clear implementations of these new policies. Mr. Bryan has been appointed as the Senior Advisor to the SECDEF on climate change; he was a former DASN for operational energy. Mr. Kidd is now the DASD (Environment & Energy Resilience), with a portfolio covering "enabling resilience and cyber-secure energy for weapon systems and installations, oversight of programs related to climate change, compliance with environmental laws, prevention of pollution, management of natural and cultural resources, and cleanup of contaminated sites, as well as energy resilience, risk, and performance." He was formerly a Deputy Assistant Secretary within the Army Secretariat. I know them both as dedicated, articulate and committed civil servants, and look forward to working with them and their offices.

The worldwide flows of natural gas are a hard-to-overestimate dimension of international politics and economics, and, as such, they play an important role in great power competition. Two recent developments in this sphere are noteworthy: the recently completed Southern Gas Corridor, and the almost completed Nord Stream 2 (NS2) natural gas pipeline. The Southern Gas Corridor routes natural gas from the Caspian to Europe, and one of its main goals is to reduce Europe's dependency on Russian gas by diversifying Europe's energy sources. NS2 will double the capacity of the existing, parallel undersea route (NS1) from Russian fields to Germany (and then onwards to get to Europe). There is some concern that NS2 increases Europe's dependence on Russia. In fact, the most recent NDAA speaks directly to this fact, and it imposes sanctions on some participants in the program. You can read about some of the EU-U.S.-Russia geopolitical tensions of NS2 in "Nord Stream 2: Implications and Outcomes for U.S.-German Relations and the NATO Alliance ", **here.**

Finally for this article, I want to mention the establishment of a new, interdisciplinary research center at NPS that was initiated by the Energy Academic Group, the Center on Combating Hybrid Threats (CCHT). In an era of Great Power Competition, we face increased challenges from hybrid threats as adversaries seek to operate in the "gray zone" which falls short of full war, is less costly, and yet is an increasingly effective space to conduct hybrid operations and campaigns. The ongoing challenges from Russia, China, Iran, North Korea, and non-state actors pertaining to hybrid threats require greater interdisciplinary attention. The Center will have three pillars, namely research, education, and outreach, and will work closely with other departments and centers on the NPS campus such as the Center for Infrastructure Defense and the Cyber Academic Group. If you're interested in this topic, please do not hesitate to reach out to me.

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ENERGY POLICY

Navy Releases Strategic Blueprint for the Arctic

**By Kristen Fletcher,
Faculty Associate-Research,
Energy Academic Group**

The crew of the Seawolf-class fast-attack submarine, USS Connecticut (SSN 22) during Ice Exercise (ICEX) 2020. (U.S. Navy photo by Mass Communication Specialist 1st Class Michael B. Zingaro)

On January 5, the Navy released *a Blue Arctic*, its "strategic blueprint" for the Arctic region in preparation for an increasingly accessible and navigable region. The document defines the Arctic region as "stretching from Maine in the North Atlantic across the Arctic Ocean through the Bering Strait and Alaska in the North Pacific to the southern tip of the Aleutian Island chain."

The document follows the 2019 Strategic Outlook for the Arctic, Arctic Roadmap 2014–2030, and 2009 Navy Arctic Roadmap. The blueprint opens by acknowledging the significant changes in the region, especially increasingly navigable Arctic waters as a result of rapidly melting sea ice. It states that a blue Arctic "will create new challenges and opportunities off our northern shores. Without sustained American naval presence and partnerships in the Arctic region, peace and prosperity will be increasingly challenged by Russia and China, whose interests and values differ dramatically from ours." While the blueprint does not reference China's claim as a "near-Arctic state," the 2019 DoD Arctic Strategy disputes the claim. With the increased investments and activities by China and Russia, the document prioritizes the need for sustained partnerships with allies within and outside the region.

> **"Without sustained American naval presence and partnerships in the Arctic region, peace and prosperity will be increasingly challenged by Russia and China, whose interests and values differ dramatically from ours."**

The blueprint shows prioritization of operating more assertively across the region "to prevail in day-to-day competition as we protect the homeland, keep Arctic seas free and open, and deter coercive behavior and conventional aggression." This includes improving the Navy's exercises and fleet synchronization above and underwater by "regionally posturing our forces, conducting exercises and operations, integrating Navy-Marine Corps-Coast Guard capabilities, and synchronizing our Fleets." Continuing joint military exercises, like the submarine-focused ICEX, are essential to evaluate and enhance American preparedness for operations in the region.

LEARN MORE

Download *a Blue Arctic* from **defense.gov**

EAG Interns have prepared two Arctic reports available at: **nps.edu/web/eag/intern-research**

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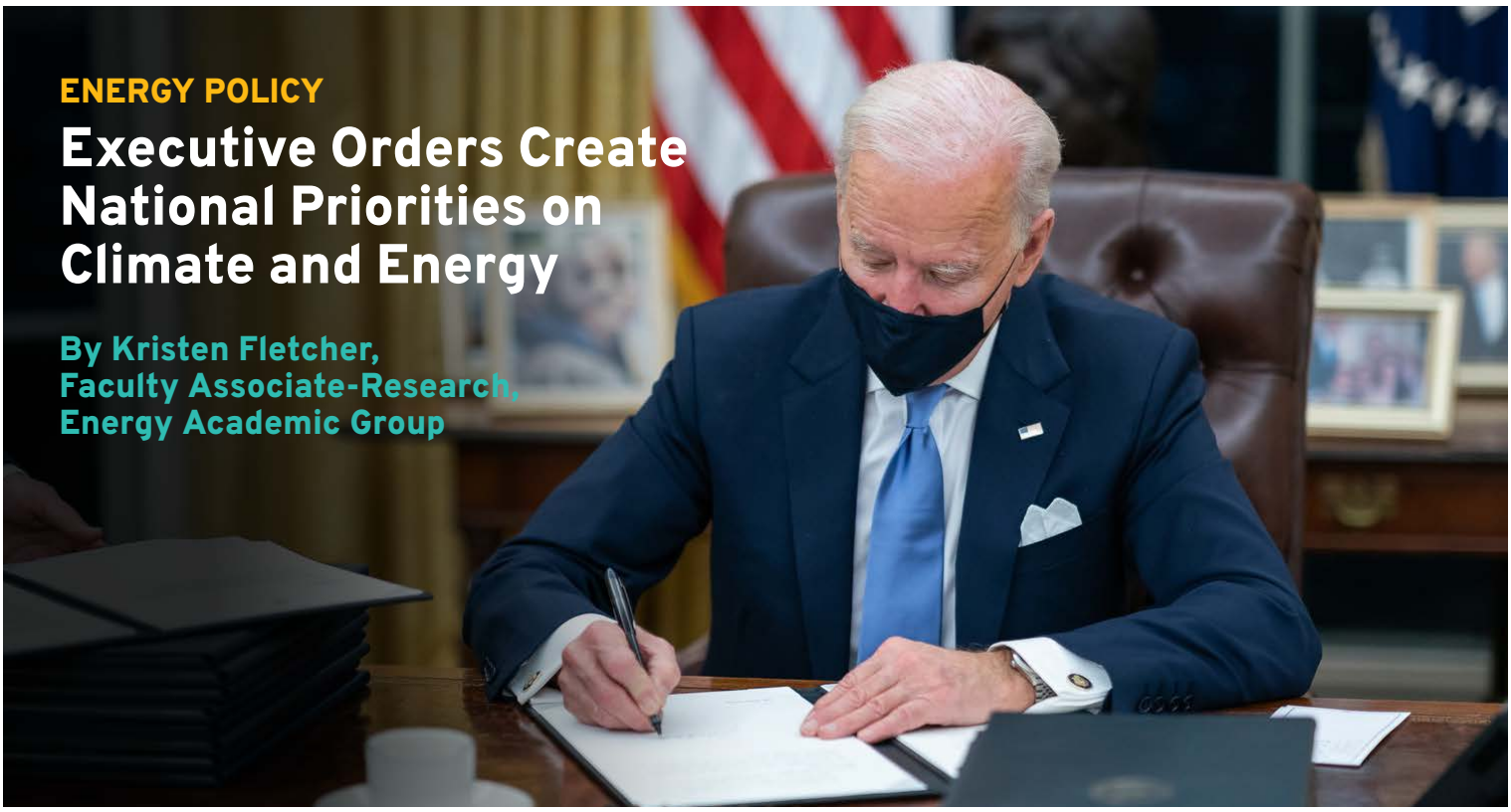
ENERGY POLICY

Executive Orders Create National Priorities on Climate and Energy

By Kristen Fletcher, Faculty Associate-Research, Energy Academic Group



President Joe Biden signs one of the 17 Executive Orders he signed on Inauguration Day Wednesday, Jan. 20, 2021, in the Oval Office of the White House. (Official White House Photo by Adam Schultz)

Between January 20 and February 4, President Biden issued three Executive Orders (EOs) which prioritize climate at the center of U.S. foreign policy and national security and instruct executive agencies regarding energy and climate actions. The Executive Orders are:

- **Executive Order 13900** (January 20, 2021): Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis
- **Executive Order 14008** (January 27, 2021): Tackling the Climate Crisis at Home and Abroad
- **Executive Order 14013** (February 4, 2021): Rebuilding and Enhancing Programs to Resettle Refugees and Planning for the Impact of Climate Change on Migration

EO 13900 calls for conservation of 30% of federal land and oceans by 2030; institutes a moratorium on new oil and gas leases on public lands and waters; and coincides with the United States reentering the Paris Climate Accord.

EO 14008 calls for the creation of a National Climate Task Force, which is chaired by National Climate Advisor Gina McCarthy, and includes senior White House officials and Cabinet-level leaders from 21 federal agencies including the Secretaries of Defense, Homeland Defense, and Energy. The Task Force will facilitate the organization and deployment of a government-wide approach to combat the climate crisis, including leveraging federal procurement to decarbonize the electricity sector by 2035 and replace government vehicles with zero-emission vehicles. EO 14008 reboots the Presidential Memorandum on Climate Change and National Security of September 21, 2016, and calls for an analysis of the security implications of climate change to be incorporated into defense planning along with deployment of clean energy technologies and infrastructure.

Secretary of Defense Austin issued a statement noting that the Pentagon will begin incorporating climate analysis into its war-gaming and analysis efforts as well as featuring the issue as part of its future National Defense Strategy. DoD will analyze its own carbon footprint and spur the "development of climate-friendly technologies at scale." Secretary Austin concluded the statement with "There is little about what the Department does to defend the American people that is not affected by climate change. It is a national security issue, and we must treat it as such."

LEARN MORE

The Climate Change EOs and Secretary Austin's statement are available at: **nps.edu/web/eag/energy-climate**

All Executive Orders and Presidential Memoranda are available at: **whitehouse.gov/briefing-room/presidential-actions**

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ENERGY POLICY

Lessons for the States on Energy Security

By Brenda Shaffer, Faculty Associate-Research, Energy Academic Group

Article originally published February 23, 2021 in RealClearEnergy and reprinted with permission.

The recent extended electricity outage in Texas has spurred a sharp debate on how to prevent future disasters in Texas and other states. Much of this debate ignores the fact that few states have adopted a proactive approach to energy security. Instead, most have left energy security matters to market mechanisms and to Washington, neither of which can deliver on local needs. States would benefit from adopting energy security policies. In crafting these policies, they can learn from the tenets of international energy security policy as practiced by many countries with smaller populations and GNP than medium and large U.S. states.

These lessons include the need for government involvement in energy security, the necessity of emergency-supply plans, the importance of diversifying fuel sources, the need for energy storage and dual-fuel power plants, and legal protection of ownership and operations of critical energy infrastructure.

Lesson one is that energy security is akin to national security, and markets alone can't provide it. Accordingly, U.S. states need energy security policies. While market mechanisms and private companies can play the dominant role in energy production, transit, and marketing, the state must stay involved in ensuring that mechanisms are in place for energy security.

Second, well-governed states develop and execute detailed emergency plans in case of disruptions of natural gas, liquid fuels, and electricity supplies. Most NATO member countries, for instance, have energy emergency-supply plans. These plans allow these governments to pre-emptively shut down energy-intensive, non-essential industries, such as cement production, desalination plants, and some manufacturing.

By doing so, governments can prevent grid collapse and ensure that those that need the supplies most, particularly residential customers, will receive energy supplies. As the recent bitter freeze loomed, Texas should have preemptively ordered such a shutdown. Instead, several days into the crisis, energy-intensive industries in Texas, like gas-liquefaction plants, chose to shut down. Texas and many other U.S. states rely on market mechanisms to direct such shutdowns, but the market mechanisms did not deliver. A simple emergency-response plan could have prevented the meltdown.

Next, diverse fuel mixes enhance security of energy supply. Following the Texas outage, interested parties sought to blame specific energy sources such as wind and natural gas for the failure. It's a good thing that Texas's electricity is produced by multiple energy sources, but as foreign countries know, energy systems need back up and redundancies. Governments need to

These lessons include the need for government involvement in energy security, the necessity of emergency-supply plans, the importance of diversifying fuel sources, the need for energy storage and dual-fuel power plants, and legal protection of ownership and operations of critical energy infrastructure.

mandate that natural gas companies store backup supplies, not leave it to the companies' discretion.

Israel, for instance, despite possessing, like Texas, vast natural gas resources in the ground, stores liquefied gas for emergency use. And some of the electricity power plants should be dual-fuel, so that when gas supplies are disrupted, they can easily transfer from one fuel type to another and keep generation going. The dual-fuel plants are less efficient, so the private market tends not to install them. Again, it falls to governments to ensure some backup plants are available when needed. Most Eastern European nations possess dual-fuel power plants to offset potential disruptions of Russian gas.

While not connected to the Texas supply outage, future disruptions could be tied to foreign actors that acquire ownership in U.S. energy infrastructure. Most foreign countries enact laws to protect their strategic infrastructure from being acquired by potential hostile actors. For instance, Lithuania in 2012 barred ownership of its energy and other strategic national infrastructure by companies that do not share a "trans-Atlantic orientation," in an effort to prevent Russian ownership of its grids and ports. U.S. states need also to assess the risks from foreign actors and put legislation in place to protect essential energy infrastructure.

Marketization of energy trade has had many worthwhile results, leading to greater supplies and lower prices of many forms of energy. However, U.S. states need to enact policies that ensure the reliability of those supplies, especially as most American communities plan expanded use of electricity. States are much better equipped than the vast federal government to provide for local security of supply of energy. Market mechanisms are not enough to get the job done. The public expects local governments to ensure secure energy supplies. When the lights go out, citizens blame their states, not private companies or Washington.

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NEW REPORT

Nord Stream 2: Implications and Outcomes for U.S.-German Relations and the NATO Alliance

Resolving the areas of contention between Germany and the United States is of the utmost importance early in President Joe Biden's term. One of these disputes is the ongoing disagreements on the Nord Stream 2 undersea natural gas pipeline. This issue comes at a difficult time as Berlin is in a precarious position regarding its energy security outlook. To meet economic and environmental obligations after the shutdown of its nuclear power plants, Germany will depend on steady imports of natural gas; and Nord Stream 2 will secure additional volumes from Russia. Ironically, this will also increase Russia's political and economic leverage over Ukraine as well as several Central and Eastern European Allies dependent on Russian gas. The U.S. has voiced strong opposition to Nord Stream 2, but Germany is determined to proceed with its construction, further complicating efforts to normalize relations between the two nations. This position paper provides three potential scenarios on Nord Stream 2, discussing the implications of each for U.S.-German relations, as well as for the NATO Alliance. Ultimately, careful diplomacy and compromise solutions from Washington and Berlin offer the best potential for ameliorating trans-Atlantic relations during a fraught election year in Germany.

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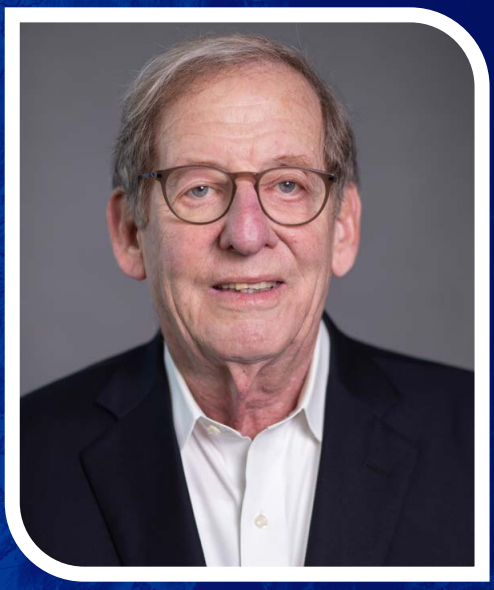
Read the entire report on the EAG's website at
nps.edu/web/eag/news

ENERGY OUTREACH

Interview with Ambassador Richard Morningstar



By Brenda Shaffer, Faculty Associate – Research, Energy Academic Group

Ambassador Richard Morningstar (retired), founding chairman of the Atlantic Council's Global Energy Center

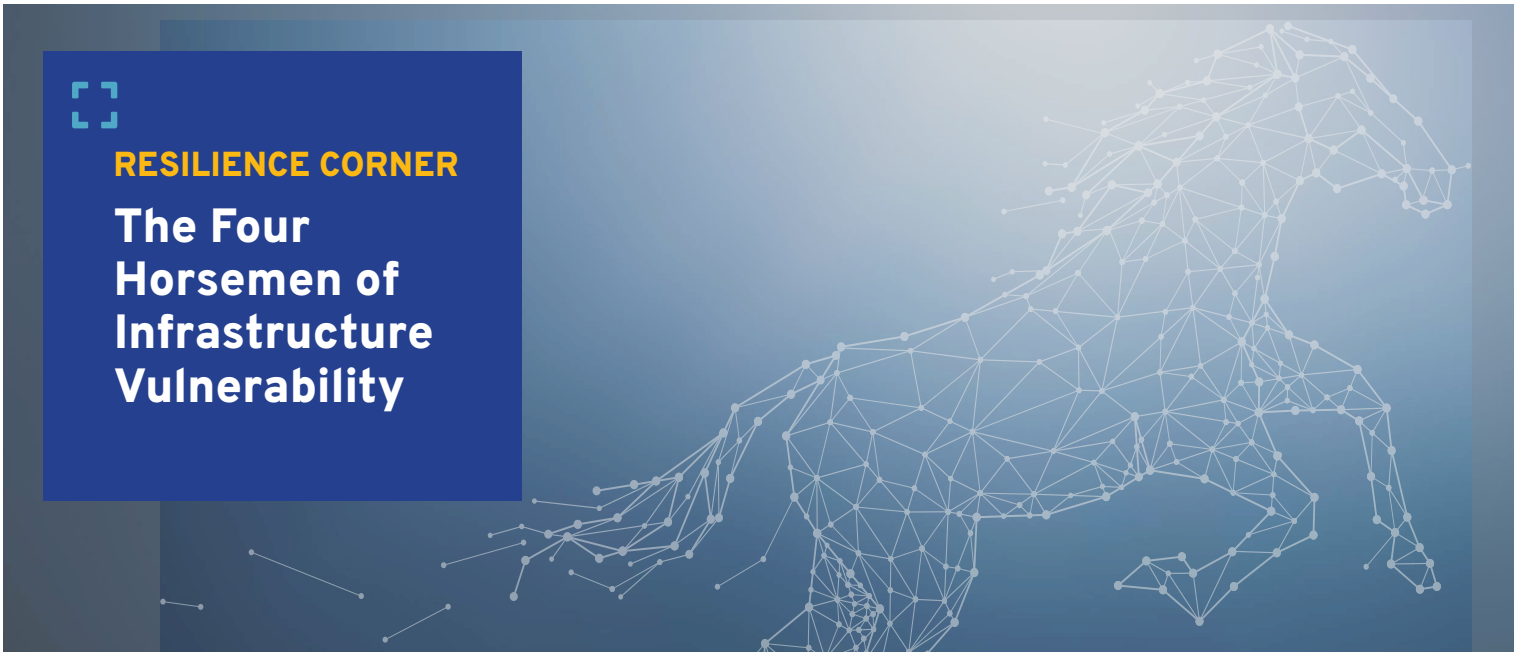
In August 2020, the Energy Academic Group held an advanced energy security course for professionals in Azerbaijan, Georgia and Turkey. The virtual course was co-sponsored with ADA University in Baku. One of the highlights of the course was an interview with (retired) Ambassador Richard Morningstar, founding chairman of the Atlantic Council's Global Energy Center. Ambassador Morningstar held a number of positions over the last three decades leading major aspects of U.S. international energy policy, including U.S. Special Envoy for Eurasian Energy and U.S. Ambassador to the EU, and U.S. Ambassador to Azerbaijan. His interview captures lessons learned on U.S. international energy policy and is an important primary document for students and researchers studying the intersection between U.S. foreign policy and U.S. international energy policy, Caspian energy, and the politics of the South Caucasus. In addition Morningstar explained "At that time, we were thinking about and we really wanted there to be a diversity of pipelines, not just pipelines going through Russia. We didn't want to see pipelines going through Iran—but it was important that pipelines go west... We really wanted to emphasize and ensure the sovereignty of the new states, Azerbaijan, Georgia, and Central Asian countries." In addition, "What was important is that this was a bipartisan policy. Republicans and Democrats both supported it. And it's been consistent since that time. With all of the issues in the United States, all the fighting back and forth between Republicans and Democrats, our Caspian policy has been fully consistent for 25 years. And I think that's been very important because it gave us credibility." On the Southern Gas Corridor natural gas project, which brings gas from the Caspian to Europe and which Morningstar worked over a decade to help establish, Morningstar remarked, "I think that the Southern Gas Corridor has been an incredibly successful project." This project brings the first new gas volumes in decades to Europe, versus pipeline projects that just reroute existing gas supplies.

LEARN MORE

Watch the full interview at nps.edu/web/eag/august-12-2020

Read the full interview at the atlanticcouncil.org

Email Brenda Shaffer at eag_poc@nps.edu



RESILIENCE CORNER

The Four Horsemen of Infrastructure Vulnerability

By Dan Eisenberg, PhD, Department of Operations Research, NPS

Resilience is a "new" term creeping into military directives, but what does it mean and how do we use it to guide decisions? Earlier in the Resilience Corner, we described how achieving resilience means improving the robustness, extensibility, restoration, and adaptation of military systems. However, improving resilience is impossible without first knowing system vulnerability.

So, how do we identify vulnerabilities? My answer to this question hinges on the idea that vulnerabilities arise from how we model the predictability and source of threats.

There are at least two ways to model threat predictability. Predictability can be modeled with *probabilities* representing the likelihood of a threat (e.g., the return period for a flood). Predictability is also modeled with *possibilities* representing imagined events that are unlikely, but possible. In the military, we often consider possibilities through wargaming and exercises to see how people respond to ficticious situations.

There are also two ways to model the source of threats. Threats can arise as a *challenge* to a system that causes assets and systems to fail. Here, experts use consequence models to estimate impacts brought by challenges. In contrast, threats also arise from *flaws* within our systems. Here, bad design or poor management can cause systems to fail. Flaws can be managed without knowing the failures or consequences they may cause.

Taken together, these perspectives allow us to organize a comprehensive framework for vulnerability analysis. Specifically, perspectives relate to four technical fields, each exemplifying one of the "four horsemen of infrastructure vulnerability" that will come to your base to tell you that your energy system is vulnerable. A comprehensive vulnerability analysis should consider each perspective prior to making recommendations on how to improve resilience.

Risk Analysis: Risk analysis identifies predictable challenges to a system. The likelihood of a risk is modeled with probability and the consequences of system failure is explicitly measured. Risk analysis is the language of the insurance industry and actuaries.

Reliability Engineering: Reliability identifies predictable flaws in a system. The reliability of a system is informed by determining the probability it will be inoperable given normal conditions. Reliability engineering focuses on updating poorly managed, out-of-date, and faulty systems before they fail. Reliability is the language of systems engineers and engineering professionals.

Adversarial Analysis: Adversarial analysis deals with possible challenges to a system. While the likelihood of an adversarial attack can only be estimated with possibility, the consequences of an adversarial attack can be explicitly measured. Adversarial analysis is the language of military and security experts.

Safety Engineering: Safety deals with possible flaws in a system. Safety concerns itself with managing dangerous conditions and tries to identify protections and precautions that prevent failures from occurring. Safety is the language of safety professionals and human factors.

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ENERGY RESEARCH

COTS Microgrid Lab Operational at NPS

By Brandon Naylor, Faculty Associate-Research, Energy Academic Group

The microgrid is housed in a 20' standard shipping container for easy to transport for future experiments in different testing environments.

The Energy Academic Group at the Naval Postgraduate School (NPS) has completed construction of a small-scale microgrid using low cost commercial off-the-shelf (COTS) parts. This microgrid facility will allow students to collect experimental data on the performance of different technologies for renewable generation, energy storage, and power distribution. The microgrid is housed in a 20' standard shipping container which makes the system easy to transport for future experiments in different testing environments. Although the COTS components used in the microgrid differ from what students might see in a forward deployed operational environment, their open architecture and component-agnostic nature makes them ideal for student experimentation; the COTS components used in the microgrid are designed to interface with a wide variety of hardware, so students will be able to integrate new components such as hydrogen or compressed air energy storage. Work is ongoing to improve the data collection capabilities of the microgrid for adavanced features such as monitoring the voltage of individual battery cells. Demonstrating COTS technologies in this microgrid lab may pave the way for future exploration or adoption of COTS energy technologies at CONUS DoD installations. Until then, the microgrid lab will serve as a valuable educational tool for students studying power electronics at NPS.

LEARN MORE

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Operational Energy Research Available on Calhoun

All NPS resident students write a thesis or capstone project report as part of their curricular requirements. Many theses are unclassified and accessible on Calhoun—the Naval Postgraduate School's digital repository for research materials and institutional publications created by the NPS community. To access theses which involve operational energy, please use the following link. New theses are added every quarter.

View operational energy theses available on Calhoun:
https://calhoun.nps.edu/

ENERGY RESEARCH

Battery Reactivity, a Key Consideration

By Eric Hahn, Faculty Associate – Research, Energy Academic Group

Energy storage is an integral component of an increasingly electrified modern battlefield. This will result in a greater need for light-weight yet energy-dense storage systems. The increasing demand for these systems has resulted in the deployment of lithium ion (Li-ion) battery technologies across the force. The requirement to enable and protect the force on the modern battlefield, as well as minimize risks of collateral damage, places a premium on efficient and effective life cycle management of Li-ion battery technology.

Key life cycle considerations of Li-ion battery systems involve efficient and effective management of not only their energy storage benefits, but also their hazardous energy risks. Steve Sloop, a technology developer focused on battery materials recycling describes it as follows: "Li-ion battery reactivity can lead to explosion, even with state-of-the-art recycling practices. To show the risk of fire and energy release with batteries, a single small cell can reach over 600˚C and melt aluminum when cut with a shearing action, like what occurs in an industrial shredder." Spent Li-ion batteries add to hazardous waste streams generated by the force. The risks and costs associated with this waste stream could be reduced or potentially eliminated with implementation of deactivation technology.

Spent Li-ion batteries add to hazardous waste streams generated by the force. The risks and costs associated with this waste stream could be reduced or potentially eliminated with implementation of deactivation technology.

Defense Logistics Agency (DLA), OnTo Technology LLC (a DLA Small Business Innovation Research Contractor), and the Energy Academic Group are collaborating on concept stage exploratory study in the southwest region to identify and prioritize specific research development locations, activities and transition needs to enable implementation of new battery deactivation technology.

LEARN MORE
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Calendar of Events

JUNE

June 29–July 2
Critical Energy Infrastructure Protection (CEIP) Analysis Workshop
Baku, Azerbaijan

Interested in Energy-related Thesis Research?

Since 2013, NPS and the EAG supported a plethora of student thesis research in the area of energy. Publicly viewable student theses can be searched from the Resources page of the EAG website at **nps.edu/web/eag/resources**. The EAG's extensive resources, intellectual capital, and connections with multi-disciplinary faculty and energy professionals provide students enhanced support for energy-related research. If interested in energy research, please reach out to the EAG team!

ENERGY ACADEMIC GROUP
NAVAL POSTGRADUATE SCHOOL

Connect with the Energy Academic Group

The Energy Academic Group is located in Room 101A, Spanagel Hall on the NPS campus in Monterey, California. A wide range of NPS faculty are affiliated with the energy program, actively participate in energy graduate education, energy executive education, and energy research. For questions, please contact one of the principal EAG faculty members:

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Contribute to an issue of *Surge*

If you would like to contribute an article or have your research/work published in the *Surge* newsletter, please contact Lois Hazard via email at lkhazard@nps.edu.

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